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SOLAR ARRAY AND TRACKING ASSEMBLY

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17853/83 F24J 3/02
85450/82 G05D 3/00
48447/79 F24J 3/02

(57) Claim

1. A solar sensor unit for a tracking solar array which array defines a solar collection surface, including:

a housing mounted on or connected to the array to angularly move therewith about a rotation axis of the array;

A pair of photo-voltaic cells on the housing, each having planar active faces, the planes of their active faces being mutually inclined, meeting at an angle of substantially 15° along a line parallel to the axis, the plane bisecting that angle being substantially orthogonal to the collection surface in use;

comparator means to measure and compare the respective outputs of said voltaic cells, and operable, in use, to cause a drive means to move the array when the outputs are unequal until the respective outputs are substantially equal.

5. A tracking solar array incorporating a solar sensor as claimed in Claim 1 including:

a shaft rotatably mounted on a support frame;

an array of solar panels mounted on the shaft;

a substantially semi-circular drive wheel mounted on the shaft;

a motor mounted on, or connected to, the support frame; and

drive means interconnecting the drive wheel and the motor.

10. An adjustable frame in combination with a tracking solar array as claimed in Claim 5 including:

a fixed upright;

an extensible upright; and

a shaft rotatably mounted on the upright so arranged that as the extensible upright is extended the axis of the shaft to the horizontal is varied.

581977

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 16.12.85

COMMONWEALTH OF AUSTRALIA

The Patents Act - 1952

APPLICATION FOR A PATENT

I RAYMOND HENRY DOW,

of 3 Mace Drive, Buderim, Queensland, 4556, Australia

hereby apply for the grant of a Patent for the invention entitled:

"SOLAR ARRAY ASSEMBLY"

which is described in the accompanying Provisional specification.

My address for service is: C/- GRANT ADAMS & COMPANY, Patent Attorneys, of 333 Adelaide Street, Brisbane, in the State of Queensland, 4000, Commonwealth of Australia.

DATED this ninth day of April. 1985 .

RAYMOND HENRY DOW,
By his Patent Attorneys,
GRANT ADAMS & COMPANY,

J.G. Adams.

TO: The Commissioner of Patents,
Commonwealth of Australia

Form 6 (Actual Inventor(s))
Regulation 12(1)

COMMONWEALTH OF AUSTRALIA
Patents Act 1952

DECLARATION IN SUPPORT OF AN APPLICATION FOR A PATENT

In support of the Application
made by RAYMOND HENRY DOW

for a patent for an invention entitled:

I RAYMOND HENRY **DOW**,
~~We~~
~~XX~~

of 3 Mace Street, Buderim, Queensland, 4556, Australia,

do solemnly and sincerely declare as follows:-

1. I am
~~We are~~ the applicant(~~s~~) for the patent.

2, I am
~~We are~~ the actual inventor(~~s~~) of the invention.

Declared at Buderim, Queensland, Australia,
this Ninth day of October, 1986.

.....
Signature of Declarant
(Raymond Henry DOW)

GRANT ADAMS & COMPANY,
333 Adelaide Street,
BRISBANE. Queensland,
4000, Australia.

TO:
The Commissioner of Patents,
Commonwealth of Australia.

55904/86

COMMONWEALTH OF AUSTRALIA

The Patents Act 1952

Name of Applicant : RAYMOND HENRY DOW

Address of Applicant : 3 Mace Drive, Buderim, Queensland, 4556, Australia

Actual Inventor : RAYMOND HENRY DOW

Address for Service : GRANT ADAMS & COMPANY, Patent & Trade Mark Attorneys, 333 Adelaide Street, BRISBANE, QUEENSLAND, 4000 AUSTRALIA.

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"SOLAR ARRAY ASSEMBLY"

The following statement is a full description of the invention including the best method of performing it known to us:

THIS INVENTION relates to a solar array assembly.

It is well-known that the efficiency of solar arrays, whether incorporating photo-voltaic (PV) cells for electricity generator, or heat absorbent collectors for hot water, is markedly increased if the array can track the sun as it tracks across the sky.

Many types of tracking systems have been devised, for simple clock-operated systems to the "Sun-Trak" (Trade Mark) collector developed by the Little Brothers. None of these have proved fully suitable to date e.g. on grounds of complexity, cost or poor tracking ability.

It is an object of the present invention to provide a tracking system for solar arrays which overcomes at least some of the disadvantages of the known systems.

Other preferred objects of the present invention will become apparent from the following description.

In one aspect the present invention resides in a solar sensor unit for a tracking solar array which array defines a solar collection surface, including:

a housing mounted on or connected to the array to angularly move therewith about a rotation axis of the array;

A pair of photo-voltaic cells on the housing, each having planar active faces, the planes of their active faces being mutually inclined, meeting at an angle of substantially 15° along a line parallel to the axis, the plane bisecting that angle being substantially orthogonal to the collection surface in use;

comparator means to measure and compare the respective outputs of said voltaic cells, and operable, in use, to cause a drive means to move the array when

the outputs are unequal until the respective outputs are substantially equal.

To enable the invention to be fully understood, preferred embodiments will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a side view of a first tracking array shown in two alternative positions;

FIG. 2 is a front view of the array (parts being shown broken away for clarity);

FIG. 3 is a schematic circuit diagram of the comparator circuit for the tracking system; and

FIG. 4 is a perspective view of a second tracking array.

Referring to FIGS. 1 and 2, the solar array 10 has a plurality of photo-voltaic cells 11 arranged on a mounting frame 12 fixed to a rotatable shaft 13, the shaft 13 being supported on a support frame 14. The output from the cells 11 is fed to a bank of storage batteries (not shown). The batteries may be connected to a suitable load e.g. an electric well pump or a light array (also not shown).

The frame 14 has a fixed front upright 15 to which is fixed a bush 16 for the shaft. The rear upright 17 has a telescopically extensible upper portion 18 fitted with a corresponding bush 19 for the shaft. The rear upright 17 is fixed to one end of a cross-shaft 20 and is braced by an inclined bracing strut 21 fixed to the other end of the shaft 20. The shaft 20 is held in clamps 22 on posts 23 and the rear upright 17 can be moved from a substantially vertical position (shown in solid lines in FIG. 1) to an inclined position (shown in dashed lines in FIG. 1) and can also be extended (as shown in the dashed lines). A telescopic strut 24 interconnects the two uprights 15, 17 to provide stability.

A semi-circular drive wheel 25 is connected to the drive shaft 13 and is fitted with a chain 26 which passes around a sprocket 27 on a stepping drive motor 28. Guides 25amaintain the chain 26 in alignment with the wheel 25.

The motor 28 is mounted on an arm 29 carried on a bush 30 journalled on the drive shaft 13, the arm being braced by a strut 31. The lower end of the arm 29 has a fork 32 which engages the strut 24 to maintain the arm 29 aligned with the front upright 15 when the rear upright 17 is extended to tilt the array 10.

To control the motor 28, the solar sensor unit 33 has a housing 34 to which is fitted a pair of photo-voltaic cells 35 (PV1 and PV2). As shown in FIG. 2, the cells are inclined to the side faces of the housing at an angle of e.g. 15^{o}.

Referring to FIG. 3, the output currents from the cells PV1, PV2 are fed to respective comparator circuits incorporating differential amplifiers.

When the array 10 is correctly aligned, equal intensities of solar light fall on the two cells and their respective outputs are zero. However, when the light intensity on one cell is greater than for the other (by a predetermined amount) one of the comparator circuits switches from the "off" state to the "on" state to cause the motor 28 to be driven until the light intensities are equal and the solar array 10 is correctly aligned. (If the solar array is swung too far the other way, the other circuit will operate to drive the array in the opposite direction). When the sky is cloudy, the array may be advanced or retarded relative to the position of the sun so that it receives the maximum amount of light.

At sunset, the array will be facing to the west. At sunrise, the difference in intensity falling on the cells will cause the motor 28 to be driven to rotate the array 10 to face the east.

By adjusting the resistors, the sensitivity of the tracking circuit can be adjustably set so that the array only moves when a predetermined intensity difference between the two cells occurs. In this way, the array is advanced in steps. Limit switches may be incorporated to prevent the array being rotated past 75^{o} to the vertical i.e. at sunrise and sunset.

Referring now to FIG. 4, the solar tracking array 40 has its shaft 13 journalled in bushes 41, 42 at the

upper ends of the fixed and adjustable uprights 43, 44. Each bush has laterally extending pins pivotally engaged in yokes 45 at the upper ends of the uprights. The solar array 10 has its photo-voltaic cells arranged in panels 46 mounted on a frame 47 which has transverse arms 48 fixed to the shaft 13 and longitudinal beams 49.

The drive for the solar array is the same as hereinbefore described with respect to FIGS. 1 and 2.

The adjustable upright 44 has a telescopically extensible upper portion 50 selectively raised or lowered by a jack mechanism 51.

The jack mechanism has a handle 52 with a collar 53 releasably connectable to the upper portion 50 by a pin which can engage holes 54 in the upper portion. The handle is mounted on a link 55 hingedly mounted on the upright 44. As the handle is pulled down, the upper portion 50 is raised and can be locked by a pin 56 engaged in one of the holes 54 and the upright 44. This allows the collar to be released and the handle raised so that the collar can be reconnected to the upper portion by the pin engaging a lower hole 54 in the upper portion (the pin 56 being released before the handle is lowered to raise the upper portion a further step).

As the sun is higher in the sky in summer than winter, the adjustable rear upright enables the array to be raised as the seasons move from summer to winter and then lowered from winter to summer, adjustment being made e.g. every 1-2 months.

It will be readily apparent to the skilled addressee that the present invention can be directed to a solar water heater, a rechargeable solar battery being used to power the motor 28. (In the embodiments described, the motor is powered from the storage battery bank).

Various changes and modifications may be made to the embodiments described without departing from the scope of the present invention defined in the appended claims.

The claims defining the invention are as follows:

1. A solar sensor unit for a tracking solar array which array defines a solar collection surface, including:

a housing mounted on or connected to the array to angularly move therewith about a rotation axis of the array;

A pair of photo-voltaic cells on the housing, each having planar active faces, the planes of their active faces being mutually inclined, meeting at an angle of substantially 15° along a line parallel to the axis, the plane bisecting that angle being substantially orthogonal to the collection surface in use;

comparator means to measure and compare the respective outputs of said voltaic cells, and operable, in use, to cause a drive means to move the array when the outputs are unequal until the respective outputs are substantially equal.

2. A solar sensor unit as claimed in Claim 1 wherein:

the comparator is operable to cause the drive means to move the array when the difference between the outputs exceeds a preset limit.

3. A solar sensor unit as claimed in Claim 1 or Claim 2 wherein:

the comparator means is operable to cause the drive means to move the array in steps.

4. A solar sensor unit for a tracking solar array substantially as hereinbefore described with reference to FIGS. 1 to 3 of the accompanying drawings.

5. A tracking solar array incorporating a solar sensor as claimed in Claim 1 including:

a shaft rotatably mounted on a support frame;

an array of solar panels mounted on the shaft;

a substantially semi-circular drive wheel mounted on the shaft;

a motor mounted on, or connected to, the support frame; and

drive means interconnecting the drive wheel and the motor.

6. An array as claimed in Claim 5 wherein:

the drive means includes a chain or rack, engageable with a sprocket or pinion, respectively on the motor.

7. An array as claimed in Claim 5 or Claim 6 wherein:

the motor is mounted on a support rotatably suspended from the shaft and engageable with the frame.

8. An array as claimed in any one of Claims 5 to 7 wherein:

the support frame includes a fixed upright and an extensible upright, the shaft being rotatably journalled in bushes at the upper ends of the uprights, the extensible upright being adjustable to enable the axis of the shaft relative to the horizontal to be varied.

9. A tracking solar array substantially as hereinbefore described with reference to FIGS. 1 to 3, or to FIGS. 1 to 3 as modified by FIG. 4, of the accompanying drawings.

10. An adjustable frame in combination with a tracking solar array as claimed in Claim 5 including:

a fixed upright;

an extensible upright; and

a shaft rotatably mounted on the upright so arranged that as the extensible upright is extended the axis of the shaft to the horizontal is varied.

11. A frame as claimed in Claim 10 wherein:

the extensible upright incorporates a jacking mechanism to selectively vary the length of the

extensible upright, the extensible upright being mounted for pivotal movement about a horizontal axis for movement relative to an upright position.

12. An adjustable frame in combination with a tracking solar array substantially as hereinbefore described with reference to FIGS. 1 and 2, or FIG. 4 of the accompanying drawings.

DATED this seventh day of December 1988.

RAYMOND HENRY DOW,
By his Patent Attorneys
GRANT ADAMS & COMPANY.

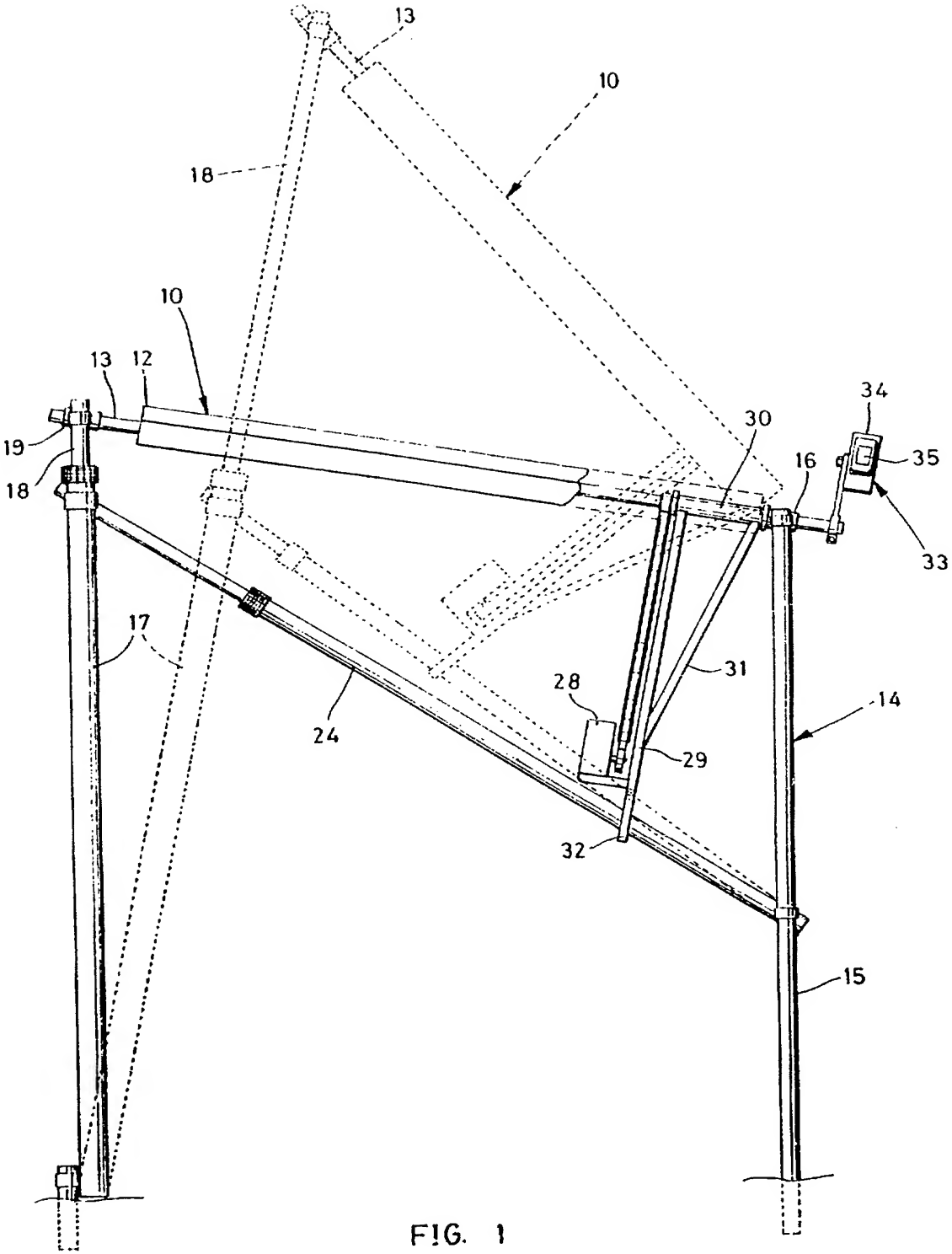

FIG. 1

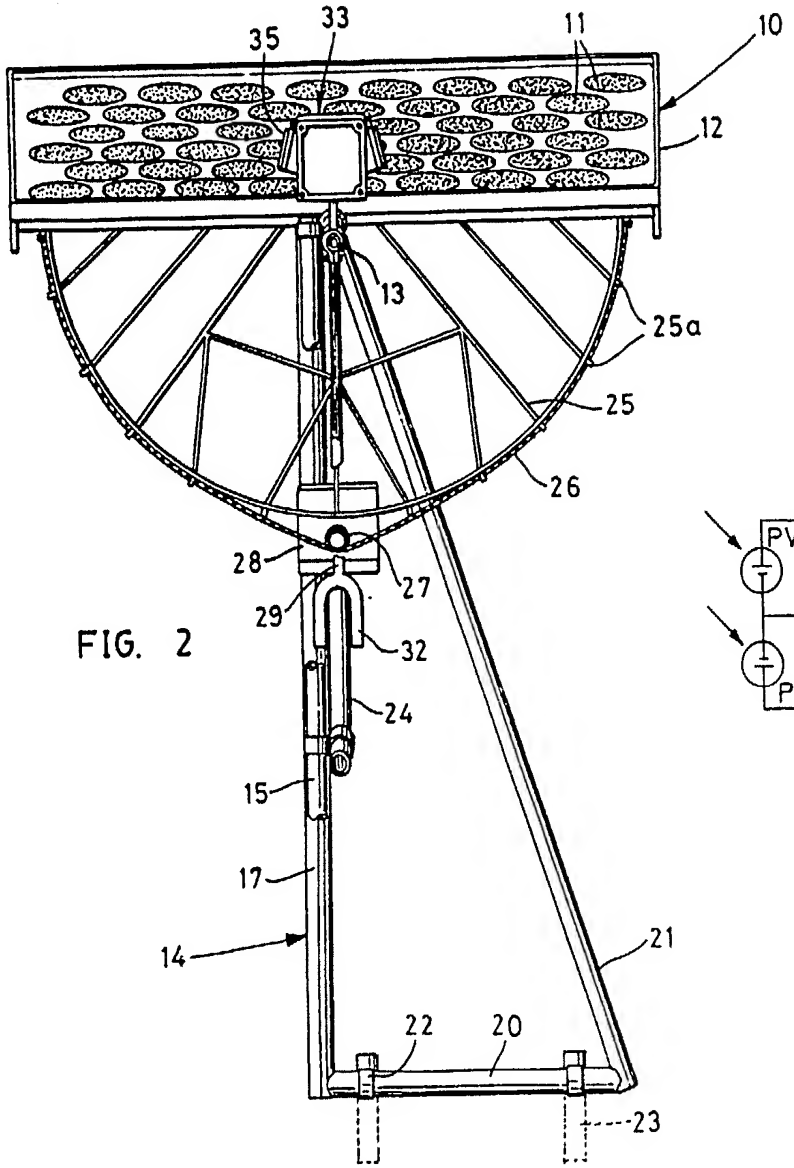

FIG. 2

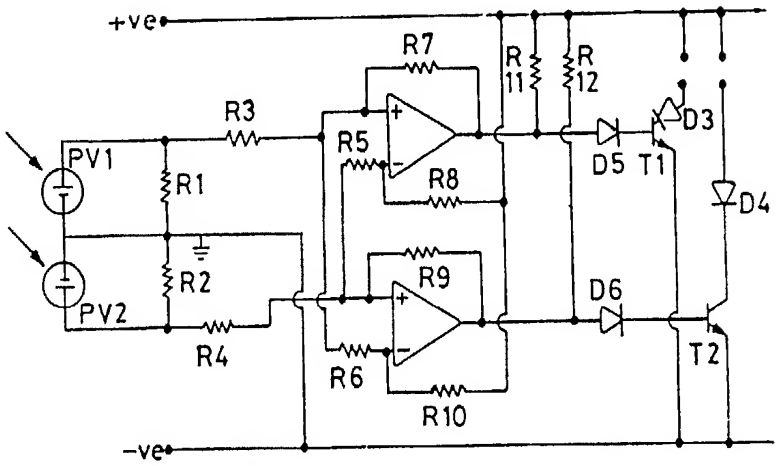

FIG. 3

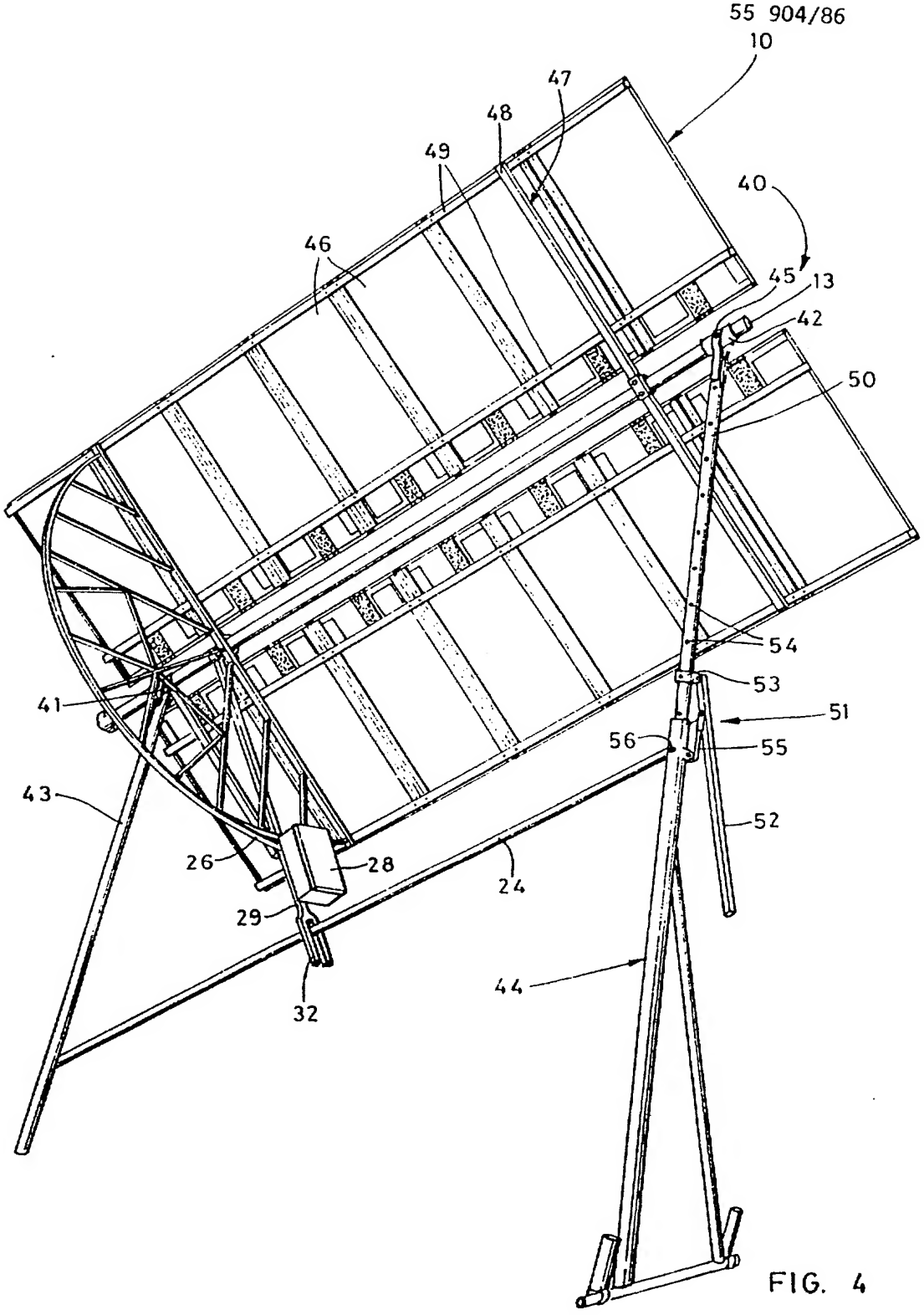

FIG. 4